

Chapter 3

Technology–Intensive Suppliers as a Key Element for Structural Change in Latin America

Yonni Angel Cuero Acosta
University of Leipzig, Germany

Isabel Torres Zapata
Universidad Santiago de Chile, Chile

Utz Dornberger
University of Leipzig, Germany

ABSTRACT

The current increase of commodity prices prompts the question regarding the extent to which the growth of primary industries is used as a basis of industrial development. Empirical evidence suggests the development of Technology-Intensive Suppliers (TIS) has played an important role in the industrialization process of the Nordic countries, Canada, and Australia. The development of local TIS may contribute to both reinforcing the industrial base and supporting structural change in developing countries. Therefore, it may provide a way to advance from natural resource dependence towards knowledge-based industrial activities. The TIS products are created under tailor-made concepts, giving solutions to their customers. TIS use knowledge and customer information to create innovation. These firms enhance value chains improving customer's competitive advantages (Dornberger & Torres, 2006). The relationship between the primary sector and its suppliers of technology can be seen as a backward linkage. Sectors with linkages of this kind use inputs from other industries (Hirschman, 1958). Hence, a fundamental goal of research in the context of developing countries is to understand the development of TIS and analysis of their improvement as a result of entrepreneurship intervention. This chapter covers the relevance of TIS firms in developing countries. TIS companies are frequently labeled as Micro-, Small-, and Medium-Sized Enterprises (MSMEs). In conclusion, the findings highlight the need to pay more attention to TIS organizations in developing economies. In Latin America, TIS firms contribute to the employment and diversification of the economic structure of the region through value-added products and services.

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INTRODUCTION

The recent natural resource-intensive prices boom has supported Latin American countries to move from a deficit in their trade balance of goods and service into a surplus (The Economic Commission for Latin America and the Caribbean [ECLAC], 2012). The region is highly dependent on minerals, hydrocarbons, and natural resource-intensive exports. However, this surplus is not a consequence of the region's capacity to achieve such a result. The ECLAC (2012) states in recent years the global economic condition has benefitted those countries which are exporters of commodities. This current increase of commodity pricing leads to the following question: To what extent can the growth of primary industries be used as a basis for industrial development?

Despite the momentum that producers of commodities are creating in Latin America, they do not create a basis which can support the industrial development of the region. Natural resource price booms are not a new phenomenon for Latin America; yet they have not been able to link the boom of primary sectors with sectors which can add more value to national production. In other words, the region bases its economic performance on the endowments of natural resources and does not create new sectors in which either capabilities or knowledge would be the distinguishing factors providing competitiveness. In this sense, the challenge for Latin American countries is to guide the commodities boom into a structural economic change which strengthens sectors through the building up of capabilities thus allowing the region to create more knowledge-intensive sectors.

Structural change occurs when a country's production shifts from primary production into a more valuable one. An example can be found in South Korea between 1960–2000 when the country “rose out of poverty, managed impressive and sustained economic growth, and improved its position in global markets by achieving technological leadership in several knowledge-intensive fields”

(OECD, 2012: 26). It is important to highlight that in the Korean case the country's policies played an essential role. Similarly, structural changes can be found in the development of countries such as Canada, Finland, and Australia which had originally produced mainly commodities but today export machinery and equipment (Dornberger & Torres, 2006; Ramos, 2001).

Structural change has been one of the core topics of Developmental Economics Theory. Researchers focusing on this concept seek the key elements which make countries either rich or poor. Among those discussing the shift in economic structures is Schumpeter who highlights the relevance of innovation in generating new sectors. Conversely, Prebisch and Hirschman argue that knowledge-intensive sectors are key elements within a country's economic production (ECLAC, 2012). Thus, structural change calls for the articulation of sectors within an economy. This articulation allows a country's economic progress to develop rapidly (Rostow, 1956). Although this articulation can initiate from primary sectors, it must develop more sophisticated sectors in order to be successful. In this regard, Latin American economies can be seen as those in a region where some primary sectors could generate development through the articulation with more valued sectors such as the providers of machinery.

In this chapter, we argue that the difference between the successful and the non-successful countries is related to the ability to create linkages between primary sectors and backwards as well as forward sectors. Countries which depend on natural resource-intensive production have to push the creation of these linkages to be able to shift their economic structure from primary to sophisticated sectors. We afford special attention to backward linkages, particularly those in which Technology-Intensive Suppliers (TIS) play an important role. Chile and Colombia are rich in natural resources as are other Latin American nations. For instance, Chile is well-known for its exports of salmon and copper. In the Colombian

case, the country's main exports are oil, coffee, and fresh flowers. Ramos (2001) highlighted that the development of countries in which production is based on natural resources resembles the development of countries such as New Zealand, Canada, and Nordic countries. In this sense, Chile's and Colombia's economic development will be based on generating suppliers and services which contribute to the competitiveness of the primary sectors.

To achieve a significant structural change, Chile and Colombia must develop backward linkages in their economies. In these nations, development of the mining, fishing, agriculture, and hydrocarbons sectors has been limited to initial stages (exploitation and extraction) (ECLAC, 2001). Chile and Colombia should strengthen the linkages between sectors, particularly the backward linkages which can promote the emergence of more sophisticated sectors. Nordic countries are an example of success of backward linkages when such linkages are the results of a network of services, knowledge, technology, machinery and new products around primary sectors (ECLAC, 2001). Furthermore, the lack of natural resources does not constrain industrial development such as the astonishing industrial development of Korea which is based on the establishment of backward linkages between ensemble sectors and suppliers of technology (OECD, 2012).

Backward linkages remain essential for economic development. Today, global competition facilitates the vertical separation of production (Bonaglia & Goldstein, 2007) which contributes to allowing Micro-, Small-, and Medium-sized Enterprises (MSMEs) to participate as suppliers to the main sectors (Nelson & Behar, 2008). Empirical evidence suggests the development of TIS firms has played an important role in the industrialization process of Nordic Countries, Canada, and Australia. For instance, Finland's forestry sector provides an example of how backwards linkages can facilitate the emergence of suppliers to companies with more complex productions. After

years of maturation, these companies evolve into competitive firms contributing to the economic performance of the country via exports. The interactions between TIS entities and their customers create an increase in technological learning which contributes to the commercialization of additional goods (Ramos, 2001).

Likewise, the Finland example shows the prevalence of manufacturing sectors, which were born from the backward linkages with primary sectors, contributes to the economic growth of this country as well as its export diversification toward more knowledge-intensive industries (Hernesniemi, Lammi, & Ylä-Anttila, 1996). Therefore, considering the development as a consequence of the performance of primary sectors is not entirely unreasonable at all. The development of local TIS companies may contribute to both reinforcing the industrial basis and supporting the competitiveness of primary production. It may, therefore, provide a way to advance from natural resource dependence towards knowledge-based industrial activities. Hence, a fundamental field of research in the context of developing countries is to understand the development of suppliers of technology and analysis of their improvement as result of entrepreneurship intervention.

The chapter is organized as follows: the first section offers the theoretical foundation for the understanding of backward linkages as well as TIS firms. The second section presents the empirical evidence from both countries Chile and Colombia. The discussion section considers the theoretical and practical implications of the findings. The chapter ends with the conclusions developed from empirical evidence.

LITERATURE REVIEW

Backward Linkage

The relationship between the primary sector and its suppliers of technology can be considered a

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backward linkage. The concept of backward linkage explains how sectors with linkages of this kind use inputs from other industries (Hirschman, 1958). Growing sectors or advanced companies stimulate the rise of other firms. They demand products and services; for instance, the automobile and manufacturing industries which use products, inputs, services, and machinery from a wide number of other industries (Perkins, Radelet, Snodgrass, Gillis, & Roemer, 2001). Therefore, the term backward linkage is understood as the relationship between either a main sector (such as mining, fishing, or agriculture), or a foreign firm which demands machinery or equipment in a local position (Battat, Frank, & Shen, 1996).

We argue that in developing countries foreign firms or commodity sectors can serve as a starting point for development. First, the extant literature on backward linkages shows in the case of natural resource intensive production how these sectors push the emergence of TIS. For example, Hernesniemi et al. (1996) reports the Finnish forest industry sector supported the emergence of machinery suppliers. This interplay facilitated the shifting of economic structures from natural resource intensive to knowledge intensive production. The newly created knowledge intensive companies facilitate the rise of manufacturing sectors within Finland. Later, the manufacturing sector helped to diversify the country's exports while simultaneously contributing to the growth of the Gross Domestic Product (GDP).

The second case found in the existing literature discussed when countries are poor in natural resources they must use foreign firms to increase GDP. In this sense, Foreign Direct Investment (FDI) acts as a source which facilitates the structural change. Countries such as Singapore, Korea, and Taiwan have made astonishing advances developing backward linkages. These countries used the transfer of capabilities as the principal characteristic of development (Battat et al., 1996). This process creates the national capacity to develop suppliers which can compete in international

markets. The concept of backward linkages is illustrated in Figure 1.

Figure 1 illustrates the role of backward linkage. When the producer is represented by foreign firms, suppliers act as providers of raw materials, machinery, and equipment under the concept of custom-tailored. In this sense, the transfer of technological capabilities from foreign firms helps the development of technological learning within the host country (Battat & et al., 1996; Kim, 1999; Ernst & Kim, 2002). Similarly, when the producer is a primary sector, it demands equipment, machinery, engineering services, or consulting. In this order, suppliers contribute to enhancing the competitiveness of the primary sector as well as the region in which they are located (Dornberger & Torres, 2006).

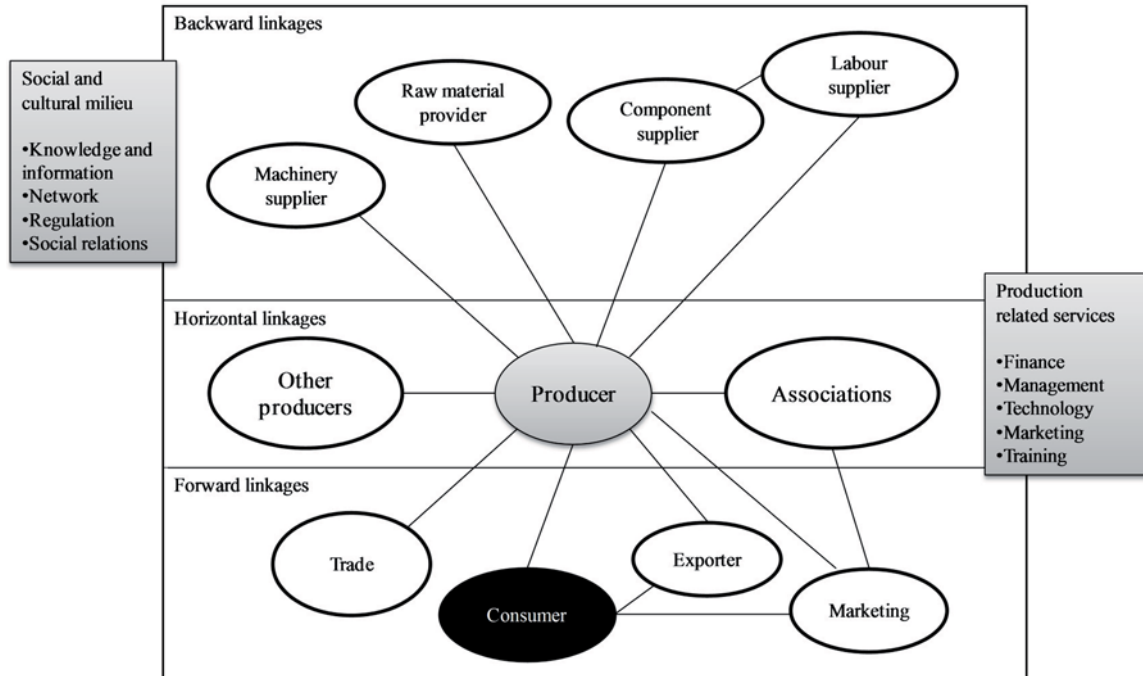
For instance, the Finnish case of development above illustrates the need for three types of suppliers: suppliers of seeds or chemistry products, suppliers of machinery, and engineering, including specialized consulting services (Ramos, 2001). Finally, Figure 1 presents the various extra benefits that backward linkages can generate; for instance, the transfer of knowledge or the establishment of network. In terms of production, the establishment of services such as financing or marketing is generated to support the relationship between producers and their suppliers.

Technology-Intensive Suppliers (TIS)

TIS entities are those firms which emerge around technological capability. These companies create strong, long-term customer relationships based on exchanging information and knowledge. Their products are created under the tailor-made concept of providing effective solutions to their customers. TIS organizations employ knowledge and customer information to create innovation. These firms enhance value chains by improving a customer's competitive advantages (Cuero, Nabi, & Dornberger, 2012; Dornberger & Torres, 2006). When TIS firms are in the first stage of

Figure 1. Conceptualization of backward linkages

Source: (Dornberger & Nabi, 2011)



Source: Dornberger and Nabi (2011)

their development, they offer their expertise for one particular industry. Thereafter, fully developed TIS businesses move to offer their products or services to other industrial sectors. Among suppliers two different groups can be distinguished: technology-intensive suppliers and knowledge-intensive services (Torres, 2010).

TIS firms provide equipment or machinery to others companies which use them for their own production. Their output must be made with high standards of quality, and most of the time with requirements from the buyer side. Among their output are equipment (such as tools), machinery (such as farming machinery), or spares (such as replacements for machinery). The interplay between TIS and primary sectors can create innovation as demonstrated in the mining sectors of Canada and Australia (Ramos, 2001). In this line of natural resources sectors, the Finnish forest industry creates suppliers in chemistry, service providers, and

paper companies (Hernesniemi et al., 1996). As Torres (2007) stresses, the increase in TIS establishments is not an exclusive process of natural resources sectors in developed countries as there exists examples in developing countries such as the aquaculture sector of Chile, the vegetable oil industry in Argentina, and the fresh flower sector in Colombia (Katz, 2006).

In Asian countries where TIS firms rose from the interplay with multinationals, there are examples which support the extant literature describing the relevance of TIS companies. First, the existence of TIS organizations supports the location of foreign firms due to the offer of local suppliers that can provide advantages in terms of fast delivery and less cost of transport (Battat & et al., 1996). Second, from the relationship between foreign firms and local TIS companies evolve spillovers which contribute to the accumulation of technical knowledge that support the develop-

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Table 1. Significant factors for the development of TIS entities

Main Industry Level	Firm Level	Industry Policy Level
Demand (size, growth, diversification, the cumulative effect of other domestic demanding industries, the scale and technology-level required)	Competitiveness (production and operations, research and development, management, financial factors, marketing and sales)	SMEs (innovation, venture, export promotion, training, technology and information transfer)
Structure (rivalry favors innovation & bargaining power of t-suppliers)	Intrinsic factors (location, size, familiar base, formality, industrial sector)	Linkages (territorial promotion, information transfer, coordination, linking dynamical sector with strategic but less dynamic ones, tax incentives, encouraging the institutional role of large buyer firms)
Geographical concentration (influences through transport costs, technological spillovers, labor pooling, cooperation, and trust)	Entry strategy (acting on the competitive factors, strategic management, cooperation)	Infant industry (credit subsidies, tax concessions, investment in infrastructure, building capabilities, coordination of activities and investments, public procurement financing of R&D, and technology support)

Source: (Torres, 2007)

ment of technological learning by the local firms. Finally, TIS can internationalize their production establishing their own brand (Bonaglia & Goldstein, 2007; Hobday, 1995).

Additionally, there is a more specific classification which can help to better describe TIS organizations. Ernst and Kim (2002) highlight there are higher-tier (or lead) suppliers and lower-tier suppliers. Higher-tier suppliers establish relationships with multinational corporations working in the Global Production Network (GPN). Their main characteristic is that “they possess valuable proprietary assets (including technology)” (Ernst & Kim, 2002: 1422). In contrast, lower-tier suppliers do not have a good position with regards to the GPN. They establish the relationship with the buyers by means of low prices and speedy, flexible delivery. “Lower-tier suppliers normally lack proprietary assets; their financial position is weak; and they are highly vulnerable to abrupt changes in markets and technology, and to financial crises” (Ernst & Kim, 2002: 1422).

However, the presence of foreign firms is not enough to enhance TIS firms as the latter require a

complex interplay between government and industry. This highlights that these companies require a period of gestation in which certain conditions arise. Afterwards, TIS entities can fill the demand that previously was only supplied by international companies. Simultaneously, they develop technology without the influence of companies overseas. Their response to the market becomes a source of progress. Table 1 presents some significant factors in the development of TIS firms.

Table 1 shows there are three levels which contribute to TIS development: main industry, firm level, and industry policy level. At the main industry level there are important boosters, such as the demand of the main sector as well as the structure and geographical location of the companies or sectors which demand TIS output. At the firm level, the size is not the only characteristic to be considered as there are other factors including location and the industrial sector. The TIS strategies are also related to their development. The government institutes policies to promote, support, and stimulate the growth of suppliers. These policies are part of the industry policy level. It is

necessary to highlight that a great percentage of TIS entities started as MSMEs; therefore, policies must create innovation or linkages keeping in mind the size of these companies. Moreover, research institutions and universities represent technical support as well as a formal source of knowledge. Although in Colombia's case the relationship between the private sector and universities is quite weak, the majority of the successful cases around the world where TIS firms were developed showed universities as an important factor (e.g., Chile, Korea, and Canada).

Although TIS companies require a complex interaction between various factors to emerge, it is necessary to understand that in the context of developing countries the institutional environment has not matured adequately to facilitate the development of these companies. TIS entities must be entrepreneurial in their activities (Amsden, 2004). Internal capabilities of TIS companies are the main source of development for these firms; particularly, the entrepreneur through his/her vision to create the business and to be able to develop it. In the case of Chile and Colombia, TIS firms possess entrepreneurs who were trained in multinational companies or want to offer a service for primary sectors. In this sense, the entrepreneur's vision is what provides origin to TIS entities. In other words, TIS companies are required to improve and develop technological capabilities through entrepreneurial activities which permeate all levels of the company.

EMPIRICAL EVIDENCE

According to ECLAC (2012), Latin America's GDP has a positive growth rate. The projections show the region will grow by around 4.0% in 2013 (ECLAC, 2012). Chile and Colombia benefit from the boom of commodity prices. Actually, this also means the region struggles when the price of commodities decreases (OECD/UN-ECLAC, 2012). Thus, countries such as Chile and Colom-

bia which are primary goods exporters suffer the consequences of variation in commodity prices.

We discovered an interesting development when reviewing the exports of these countries. The total exports for Chile and Colombia represent 38.7% and 15.7%, respectively, of the GDP in 2011 (OECD/UN-ECLAC, 2012). The main composition of the GDP of these countries is the production of primary goods. Despite the significance of exports for the economic performance of these countries, they are not world leaders in the exports of natural resources. As was previously stated, the fact is that countries producing primary goods can be a source of economic progress. Moreover, empirical evidence of the Nordic countries proves that natural resources-based sectors contribute to the diversification of a country's exports composition. However, this diversification must be accompanied by the incorporation of technology and knowledge within production, as well as national policies to support the development of new sectors (ECLAC, 2008).

To support the argument of developing manufacturing sectors from natural resource bases, it is necessary to observe the composition of world exports. Manufacturing exports accounted for almost 86% of world goods exports in 2005 – the other portion was primary product exports (Kuwayama, 2009). As mentioned earlier, despite the fact that the Latin American region possesses a strong comparative advantage in primary goods production, this region only contributed 14% to global primary exports in 2005 (Kuwayama, 2009). Table 2 presents the technological composition of the exports from Chile and Colombia. It shows these countries are dependent on their primary sectors to export, but they are not participating significantly in the world primary exports. Essentially, they are not leaders in this sector.

Chile and Colombia should use their strengths in primary sectors to encourage industrialization. The industrialization process, seen as result of the boost of manufacturing sectors, contributes to an increase in the technological base of a country

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Table 2. Technology composition of exports in Chile and Colombia in 2005

Country	Primary Products	Natural Resource-Based Manufactures	Low-tech Manufactures	Intermediate-Tech Manufactures	High-Tech Manufactures
Chile	37.3	53.5	2.5	6.1	0.6
Colombia	48.2	18.6	13.7	16.6	2.8

Source: Kuwayama (2009)

because industrialization demands technical knowledge, skilled workers, economies of scale, learning processes, innovation, and technological advances (Tregenna, 2011). Importantly, the major contribution of the manufacturing sector is its role in the consolidation of forward and backward linkages (United Nations Conference on Trade and Development [UNCTAD], 2006).

Kuwayama (2009) argues that industrialization based on manufacturing activities emitting from natural resources-based sectors is ideal for Chile and Colombia. The extant literature acknowledges that economies basing their production on natural resources depend on the volatility of external forces not under their control. This line of argument suggests that natural resources-based sectors can become a source of knowledge-intensive industries and services (De Ferranti, Perry, Lederman, & Moloney, 2002). “The recent success of Chile, with the highest growth rate in the region in the last 25 years, has been almost fully led by exports of natural resource-based products.” (Kuwayama, 2009, p.56). Additionally, natural resources-based sectors call for the integration of public research institutes and universities which contribute to strengthening national innovation within countries.

Participation of MSMEs

The role of MSMEs in Latin America is important to the economic performance within countries, particularly in Chile and Colombia. Table 3 shows how MSMEs participated in the development of the economies in Chile and Colombia. MSMEs constitute 99% of the total number of firms within these countries, so policy makers should consider the promotion of MSMEs regarding the economic progress of these countries.

Despite the significant number of MSMEs within the economies of Chile and Colombia, these firms maintain the tendency of the region. MSMEs provide many jobs in Chile and Colombia, but they do not participate in GDP or exports (OECD/UN-ECLAC, 2012). This situation is reflected in the social and economic problems that Chile and Colombia have today. The fact that MSMEs do not exhibit high levels of productivity can generate a vicious circle. Firms which do not demand skilled workers or technological knowledge cannot contribute to the long-term economic development of a country. By contrast, when firms call for more knowledge-intensive activities they foster innovation within countries. MSMEs can play a role within an economy as TIS entities. Figures 2 and 3 illustrate this characteristic.

Table 3. Proportion of firms by size in selected countries

Country	Micro	Small	Medium	Large
Chile	90.4	7.8	1.2	0.6
Colombia	93.2	5.5	1.0	0.3

Source: OECD/UN-ECLAC, (2012)

Figure 2. Typical industrial organization in developed countries

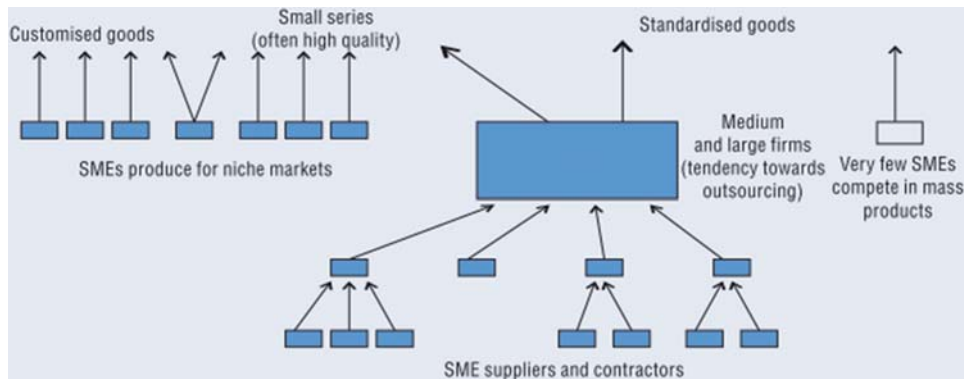


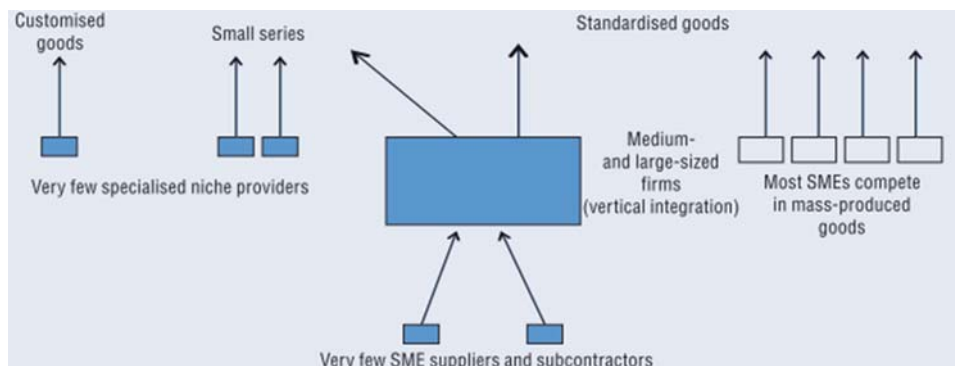
Figure 2 shows an ideal framework from developed countries. There are two main characteristics that deserve attention. First, Small- and Medium Enterprises (SMEs) produce for specific or niche markets following the tailor-made concept. Additionally, SME production presents high quality. Of course, these two features mean SMEs do not compete in mass-produced goods. Second, the vertical integration at the center of the Figure 2 shows there is an extension for the development of suppliers. It is this area in which TIS firms emerge. In contrast, Figure 3 represents the structure in developing countries in which it can be seen that although SMEs are the majority of firms, they compete in mass-produced goods where there is no exigency for specifications. This situation impacts the quality of production. Vertical integration, as

discussed in the second characteristic of Figure 2, can develop a great line or quantity of suppliers. We can infer this vertical integration can serve as a source of economic progress when main sectors develop their backward linkage.

CONCLUSION

The findings of this research highlight the need to pay more attention to TIS companies in developing countries. Although Chile and Colombia present successful cases in some sectors, these countries require perseverance in their policies to promote backward linkages from their natural based sectors. Primary sectors have to be connected with TIS entities in order to develop manufacturing

Figure 3: Typical industrial organizations in developing countries
Source: Altenburg & Eckhardt (2006) in OECD/UN-ECLAC, (2012)



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activities within the countries. In this sense, Chile and Colombia can achieve structural change in their economic structure through the creation of more knowledge-intensive sectors and services.

TIS companies are fundamental sources of innovation as well as technological progress. The solidification of backward linkages has been delayed in Latin America region; moreover, pressure from the development of Asian countries condemned the Latin American region to limit its opportunities to catch up. TIS organizations must be promoted in Chile and Colombia to obtain the potential effects these types of companies can have on GDP and exports. Policies which consider the participation of MSMEs and the development of technological capabilities and innovation must combine the efforts of governmental institutions within industrial organizations. The strengthening of backward linkages in Chile and Colombia will benefit the structural change process.

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KEY TERMS AND DEFINITIONS

Backward Linkage: Relationships established by companies with their suppliers to share knowledge, information and finance resources.

Commodity: A produced good without quality differentiation.

Entrepreneurship: The capacity to manage a business venture in order to obtain profit.

Industrialization: A social-economic change which transform a society from agrarian stage into an industrial one.

Natural Resources: Extraction, exploitation and commercialization of resources which are in the environment.

Technology-Intensive Suppliers: Providers of equipment and/or specialized services. These equipment and services are result of knowledge-intensive activities.

Technological Capability: An ability to apply knowledge into products and process to operate and to create technology.